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SOUTHEAST 14TH STREET BRIDGE
Iowa Bridges Recording Project
Spanning over Des Moines River
on U.S. Highway 65/69
Des Moines
Polk County
Iowa

HAER No. IA-84

BLACK & WHITE PHOTOGRAPHS
WRITTEN HISTORICAL & DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Department of the Interior
P.O. Box 37127
Washington, D.C. 20013-7127

HISTORIC AMERICAN ENGINEERING RECORD

SOUTHEAST FOURTEENTH STREET BRIDGE

HAER No. IA-84

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Location: Spanning the Des Moines River on U.S. Highway 65/69 (SE 14TH Street) in Des Moines, Polk County, Iowa
UTM: 15.450260.4602590
USGS: Section 11, Township 78 North, Range 24 West

Date of Construction: 1936-37

Designers: Sverdrup and Parcel, St. Louis, Missouri

Builders: E.A. Kramme Company, Des Moines, Iowa

Fabricators: Unknown

Present Owner: Iowa Department of Transportation

Present Use: Highway bridge

Significance: The SE 14th Street Bridge maintains its original appearance while demonstrating the high quality of bridge design and construction in the 1930s of continuous span technology.

Historians: Richard Vidutis, James Hippen

Project information: This document was prepared as part of the Iowa Historic Bridges Recording Project performed during the summer of 1996 by the Historic American Engineering Record (HAER). The project was sponsored by the Iowa Department of Transportation (IDOT). Preliminary research on this bridge was performed by Clayton B. Fraser of Fraserdesign, Loveland, Colorado.

INTRODUCTION

Located on U.S. Highway 65 in Des Moines, the SE 14th Street Bridge crosses the Des Moines River in the southern part of the city. Its important function is to keep traffic away from the city's center while providing easy access to the state capitol. The river bridge on this vital route through Iowa's capital city employed the latest bridge engineering trends of its day by building a steel structure with a continuous deck girder. Built with federal funds, the SE 14th Street bridge is a well preserved example of the use of continuous technology in bridge design and construction from the 1930s.

Des Moines began as a military outpost and was called Fort Des Moines. Its earliest function was to protect the first settlers in Indian territory and was built at a strategic spot where two rivers met, the Des Moines River to the east and the Raccoon River to the south. With settlement increasing, the surrounding lands were open to settlement and Fort Des Moines became simply Des Moines, but remained the area's most important settlement. After Iowa became a state in the Union in 1847, Des Moines became its capital.

HISTORY, DESIGN AND TECHNOLOGY OF THE SE 14TH STREET BRIDGE

On March 17, 1936, Iowa State Highway Commission Chief Engineer, Fred White announced to the IHC Board that he, according to the board's wishes, entered into an agreement with Sverdrup and Parcel to prepare detailed designs for the bridge over the Des Moines River and the viaduct over various railroads on East 14th Street in the city of Des Moines. The amount paid Sverdrup and Parcel for the preparation of plans was \$15,000, an amount slightly less than three percent of the estimated cost of the two structures.¹ Bids were requested for the structures and, on June 23, 1936, contracts were let.² The low bidder on the bridge over the Des Moines River on East 14th Street and on the East 14th Street viaduct was G.G. Herrick, General Contractor, Des Moines. But G.G. Herrick had inclosed a note with his bid stating that if he was the low bidder on the East 14th Street viaduct, then his bid on the bridge should be considered void. The board complied

¹Iowa State Highway Commission Minutes, March 17, 1936.
Located at the Iowa Department of Transportation, Ames, Iowa.

²Iowa State Highway Commission, *Weekly Letting Report* 24:26
(June 24, 1936), p. 9.

and rejected Herrick's bid for the bridge.³ On June 25, 1936, contracts were awarded to G.G. Herrick, Des Moines, to complete a viaduct over the railroads on East 14th Street for \$294,472.72, and to E.A. Kramme Co., Inc., Des Moines, to build a continuous steel deck girder over the Des Moines River on East 14th Street for \$219,093.95.⁴

Two major types of bridges are used extensively in Iowa in the late twentieth century for medium and large spans. These are the continuous steel girder and the precast, prestressed concrete girder. The prestressed girder has come into use since World War II, but the continuous bridge has a long history. The SE 14th Street Bridge represents an important step in the emergence of this technology from experimental to common use.

The continuous beam, girder, or truss bridge has the advantage over simply supported structures in a saving of material and greater stiffness.⁵ This was demonstrated on a grand scale by Robert Stephenson's Britannia Bridge, completed in 1850.⁶ American engineers, however, were slow to adopt the idea of continuity in a bridge, considering it impractical both because of its vulnerability to the effects of any pier settlement and the difficulty of calculating the stresses involved.⁷ Some very few examples were built in North America, and the theory found its way into textbooks, but the attitude of the great majority of engineers was summed up, and fortified, by J.A.L. Waddell (the pontifex maximus of the profession) who concluded "few American engineers will countenance the building of continuous girder bridges."⁸ In 1917, the next year, Gustav Lindenthal completed the great Sciotoville, Ohio, continuous truss, and engineers

³Ibid., June 24, 1936.

⁴Ibid., June 29, 1936.

⁵The principle of continuity is clearly explained in Harry Parker, Simplified Design of Reinforced Concrete (New York: Wiley, 1943), chapter 3, and later editions of the same work.

⁶Charles Singer, et al. A History of Technology, 5 The Late Nineteenth Century (Oxford: Clarendon Press, 1958), pp 504-505.

⁷George A. Hool and W.S. Kinne, Movable and Long-Span Steel Bridges, 2nd ed. (New York: McGraw-Hill, 1943), pp. 199-201.

⁸Bridge Engineering I (New York: Wiley, 1916), p. 482.

began a slow realization of the practical possibilities in the continuous approach.⁹

In Iowa, as in the profession generally, engineers approached the previously condemned idea with care. In trusses and in girders the nearest thing to a continuous structure is a cantilever. For major bridges, such as crossings of the Mississippi and Missouri rivers, cantilever trusses had been used for decades. The first large continuous truss was the Nebraska City bridge over the Missouri, built in 1929.¹⁰ Others were built in the 1930s over the Mississippi, the Missouri, and the Des Moines rivers.

Of wider importance throughout the state was the gradual acceptance of continuous bridges for moderately large crossings. The first, so far as is known, was designed by the highway commission to replace a Luten patented arch that had collapsed in Ames. Built to carry the Lincoln Highway over Squaw Creek, the bridge was a three-span steel through plate girder, and it was continuous. The inflammatory word "continuous" was not used, however, in describing the bridge. The captions to published photographs merely call attention to the beauty of the "continuous curve" of the camber of the bridge, "instead of a series of lines breaking at the pier points."¹¹ Also noted is the fact that the three girders are "permanently connected to each other end to end," thus saving in the number of supports needed on the top of the piers.¹² If this seems to press the issue of disguising the new a bit far, it is well to note that when the state highway system was established two years earlier, "so great was the opposition to the word 'state' and a state-controlled road system, that legislators, fearing for their political futures, names it the 'Primary Road System'."¹³

⁹Carl W. Condit, American Building Art: The Twentieth Century (New York: Oxford University Press, 1961), pp. 92-100.

¹⁰Sverdrup & Parcel, Engineering Projects (St. Louis: 1946).

¹¹Iowa State Highway Commission, Service Bulletin 9 (March-April, 1921):3.

¹²Ibid., p. 5.

¹³William Thompson, Transportation in Iowa: A Historical Summary (Ames: Iowa Department of Transportation, 1989), p. 73.

The cantilever design was also used first with regard to concrete structures. As early as 1905 a concrete cantilevered girder was built for the street railway in Marion.¹⁴ The highway commission experimented with reinforced concrete cantilever girders, beginning with one at Woodbine (also on the Lincoln Highway) in 1917. Others followed, noted in the bridge design section of the commission's Annual Reports.¹⁵ In 1926 the commission reported the design of a "monolithic concrete girder" that "makes use of the cantilever principle."¹⁶ This was the Winnebago River bridge (HAER No. IA-78) just north of Mason City.

But things began to change more rapidly. Other states were also introducing the continuous bridge.¹⁷ By 1929 an editorial in the Engineering News-Record proclaimed that "structural views have made distinct progress since the days when continuous bridges were considered bad practice."¹⁸ Iowa began to regularly construct continuous bridges, usually of the steel plate girder variety.¹⁹ Those that were built in the 1930s are remarkable examples of innovative design in response to the demands of the age of automobiles and highways.

¹⁴This may have been the first such bridge in the nation. Carl Condit, American Building (Chicago: University of Chicago Press, 1968), p. 257.

¹⁵Those listed in Fraserdesign, Iowa Historic Bridge Inventory (1993), are Herrold, 1921 (POLK13), Goldfield, 1921-22 (WRIG27), Okoboji, 1929 (DICK01), and Spirit Lake, 1939 (DICK02).

¹⁶Iowa State Highway Commission, Annual Report for 1926, p. 15.

¹⁷Oregon State Highway Commission, Eighth Biennial Report...1926...1928 (Salem, Oregon: 1929), p. 71.

¹⁸Ibid., January, 17, 1929, p. 89.

¹⁹The conclusion that few concrete continuous bridges were built is tentative. The Iowa Historic Bridge Inventory rarely identifies continuous structures, so it is of little value in checking among the surveyed items for this structural type. From an economic point of view, concrete continuous girders, due to cost of formwork, would usually be more expensive, thus less common. The concrete bridge really came into its own with the introduction of prestressed beams after World War II.

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The SE 14th Street Bridge, in addition to responding to the always difficult problem of getting to the various parts of Des Moines with two major rivers joining in the center of the city, provided a necessary relief to highway traffic that had to thread its way through the center of the city. U.S. Highway 65 (the old Jefferson Highway) passed through Des Moines on the way from Canada to the Gulf of Mexico. The new bridge, along with its northerly companion, the SE 14th Street Viaduct over the railroad yards, kept highway traffic away from downtown, and provided improved access to the state capitol.²⁰

For this important river crossing the Iowa State Highway Commission turned to the engineering firm of Sverdrup and Parcel of St. Louis. They were active and well known bridge designers in the Midwest. They had made a noteworthy contribution to the Iowa bridge roster with the Nebraska City bridge (over the Missouri River into Fremont County, Iowa) in 1929. This was a through truss bridge, built on the principle of continuity of the structure over more than two supports, a type just on the verge of becoming widely accepted by the American engineering profession. By 1936, when Sverdrup and Parcel were called upon to design the Des Moines River bridge, continuous girder as well as continuous truss structures were one of the most common solutions to the problem of bridging Iowa's rivers.²¹

Iowa was conforming to at least two national trends in the building of this bridge. There was the choice of a continuous design and there was assistance from the federal government to help relieve the unemployment brought on by the Great Depression. Shortridge Hardesty, of Waddell & Hardesty, Consulting Engineers, in reviewing bridge engineering for the year 1936 noted that "there was a large volume of moderate-sized and small bridge work under way during the year, much of it with the aid of PWA and other federal money."²² Albin L. Gemeny, Senior Structural Engineer, U.S. Bureau of Public Roads, noted a year later that "there was a continuing inclination among engineers toward the use of steel, instead of concrete, for structures where these two materials were competitive." And he made another point which accurately described the SE 14th Street bridge. Gemeny wrote that

²⁰Gallup Map and Supply Co., Highway Atlas of the United States (Kansas City: 1934), pp. 28-29, 70.

²¹Sverdrup and Parcel, Engineering Projects (St. Louis: ca. 1946).

²²Engineering News-Record 118 (February 4, 1937):178.

"in the field of steel bridges multiple simple spans have almost gone into the discard. Continuous beam and girder spans are being generally adopted for intermediate lengths."²³

The SE 14th Street crossing built in 1936-37 was a "750' deck plate girder bridge, two 105' spans and four 135' spans."²⁴ The six spans were each six girders wide. The riveted plate girders are in the order 105-135-135-135-135-105. All support shoes were expansion except on the center pier, which had fixed supports. In order to properly stress the girders so that the principle of continuity would work to full advantage, a negative moment (upward thrust) had to be developed over the piers. This was accomplished by a careful placing sequence for the concrete floor slab: the portions over each pier were poured last.²⁵

The bridge was a completely successful exercise in the use of continuous technology, and has lasted well to the present. Its only flaw, shared by so many bridges of that era, was that it could not forever handle the constant increase in motor traffic. Consequently, in 1971 a design was prepared to widen the bridge.²⁶ This was accomplished very neatly by adding concrete corbels to the ends of the original piers, sliding the original girders (sidewalks and all) apart, and adding three new welded girders in between. This retained almost completely the original appearance of the bridge while adding to its capacity. Today the bridge maintains its elegant efficiency in carrying traffic, and it demonstrates the high quality of bridge design and construction of the 1930s.

²³Ibid., 120 (February 10, 1938):233.

²⁴Design No. 2036, Polk County, Sverdrup and Parcel for Iowa State Highway Commission, May 1936-July 1937. Iowa Department of Transportation.

²⁵Design, sheet 5.

²⁶Design No. 170, Polk County, Harrington and Cortelyou for Iowa State Highway Commission, April 1971, Iowa Department of Transportation, file no. 23825.

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APPENDIX A Bridge Designs for the SE 14th Street Bridge

Microfilm files located at the Iowa Department of Transportation, Ames, Iowa. Filed under: File 10802, Design 2036, Design 2136, and Design 170.

1. *State of Iowa State Highway Commission Design for Des Moines River Bridge. East 14th Street, Des Moines. U.S. Works Program Grade Crossing Project No. W.P.M.H. 104. Primary Road System. Polk Co. June 1936. Sverdrup and Parcel, Consulting Engineers, St. Louis, Mo. Design No. 2036. [8 sheets]*
2. *140' Deck Girder Bridge, 42' Roadway, Two 5' Sidewalks. Project No. W.P.G.M. 104. E 14th Street, Des Moines, Polk Co. ISHC. Sverdrup and Parcel, Consulting Engineers, St. Louis, MO. Crossing 1091. Design No. 2136 Polk County. [15 sheets]*
3. *Design for Widening 750' x 42' Plate Girder Bridge with 2-5' Sidewalks to 750' x 56' Plate Girder Bridge with 2-4' Sidewalks. April 1971. File No. 23825. Design 170. Project No. U-69-4(9)-40-77. [114 sheets]*

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APPENDIX B List of Illustrations

- Fig.1 Profile Sketch of SE 14th Street Bridge. James Hippen,
 1996.
- Fig.2 USGS Map. Des Moines SE Quad., 1956. 7.5 min. series
 (topo.).

SE 14TH STREET BRIDGE

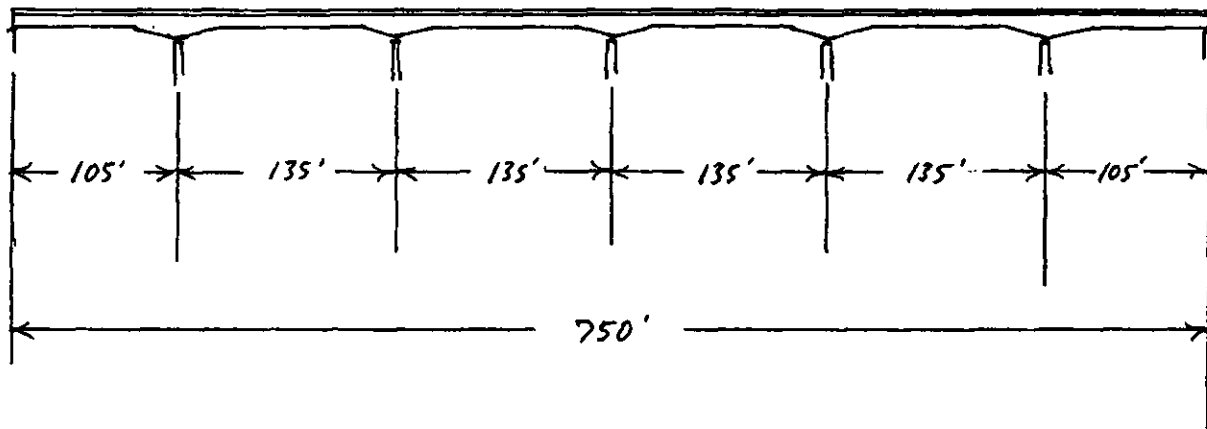


Fig.1 Profile Sketch of SE 14th Street Bridge. James Hippen, 1996.

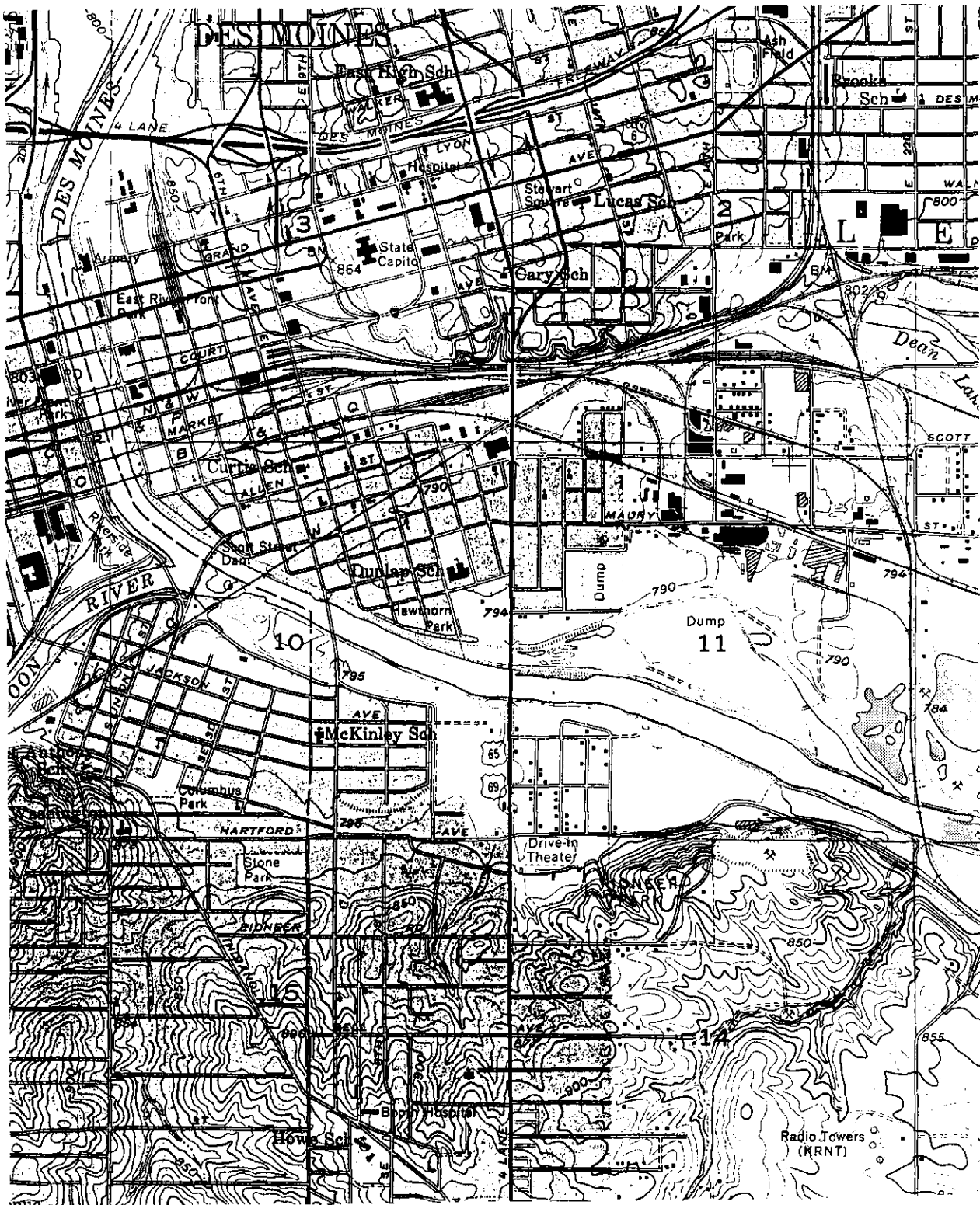


Fig.2 USGS Map. Des Moines SE Quad., 1956. 7.5 min. series (topo.).

ADDENDUM TO
SOUTHEAST FOURTEENTH STREET BRIDGE
Iowa Historic Bridges Recording Project II
Spanning Des Moines River at U.S. Highway 65/69
Des Moines
Polk County
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This appendix is an addendum to a 13-page report previously transmitted to the Library of Congress.

APPENDIX: ADDITIONAL REFERENCES

Interested readers may consult the Historical Overview of Iowa Bridges, HAER No. IA-88: "This historical overview of bridges in Iowa was prepared as part of Iowa Historic Bridges Recording Project - I and II, conducted during the summers of 1995 and 1996 by the Historic American Engineering Record (HAER). The purpose of the overview was to provide a unified historical context for the bridges involved in the recording projects."